WHAT IS CLAIMED IS:

1. A frequency converter, comprising:

an oscillator for generating N clock signals with a predetermined oscillation frequency, the N clock signals having phases sequentially shifted, each of the clock signals including an oscillation signal and an inverted oscillation signal having an inverted phase with respect to the oscillation signal; and

a mixer for receiving a predetermined radio frequency (RF) communication signal and providing a modulated output signal by down-modulating a frequency of the RF communication signal using the N clock signals, wherein the mixer comprises:

a load unit including a first load element arranged between a predetermined supply voltage and a positive output terminal and a second load element arranged between the supply voltage and a negative output terminal, the load unit generating the modulated output signal according to a voltage difference between signals provided to the positive and negative output terminals;

an input unit responding to the RF communication signal; and

a driving unit coupled to the input unit for controlling current signals flowing through the first and second load elements, respectively, in response to the N clock signals to generate the modulated output signal.

2. The frequency converter according to claim 1, wherein:

the input unit includes N source stages each responding to the RF communication signal; and

the driving unit includes N driving stages each having a first transistor responding to the oscillation signal of corresponding one of the clock signals and a second transistor responding to the inverted oscillation signal of the corresponding one of the clock signals, the first and second transistors having first side ends connected to corresponding one of the source stages and second side ends electrically connected to the positive and negative output terminals, respectively, such that a connection of the second side ends of the first and second transistors of a driving stage is contrary to that of an adjacent driving stage.

3. The frequency converter according to claim 2, wherein the N is three.

4. The frequency converter according to claim 2, wherein the source stages each include a transistor that is controlled by the RF communication signal and has a conduction path between corresponding one of the driving stages and a ground voltage.

5. The frequency converter according to claim 4, wherein the first transistor is gated by the oscillation signal and has a conduction path between the first load

element and the transistor of corresponding one of the source stages, and the second transistor is gated by the inverted oscillation signal and has a conduction path between the second load element and the transistor of the corresponding one of the source stages.

6. The frequency converter according to claim 1, wherein the input unit includes:

N positive source stages each responding to the RF communication signal; and

N negative source stages each responding to an inverted RF communication signal having an inverted phase with respect to the RF communication signal.

7. The frequency converter according to claim 6, wherein the driving unit includes:

N positive driving stages each having a first transistor responding to the oscillation signal of corresponding one of the clock signals and a second transistor responding to the inverted oscillation signal of the corresponding one of the clock signals, the first and second transistors having first side ends connected to corresponding one of the positive source stages and second side ends electrically connected to the positive and negative output terminals, respectively, such that a connection of the second side ends of the first and second transistors of a positive driving stage is contrary to that of an adjacent positive driving stage; and

N negative driving stages each having a third transistor responding to the oscillation signal of corresponding one of the clock signals and a fourth transistor responding to the inverted oscillation signal of the corresponding one of the clock signals, the third and fourth transistors having first side ends connected to corresponding one of the negative source stages and second side ends electrically connected to the positive and negative output terminals, respectively, such that a connection of the second side ends of the third and fourth transistors of a negative driving stage is contrary to that of the first and second transistors of corresponding one of the positive driving stages.

8. The frequency converter according to claim 7, wherein the N is three.

9. The frequency converter according to claim 1, wherein the input unit includes:

a first input transistor arranged between the positive output terminal and a positive auxiliary terminal to respond to the RF communication signal;

a second input transistor arranged between the negative output terminal and the positive auxiliary terminal to respond to an inverted RF communication signal having an inverted phase with respect to the RF communication signal;

a third input transistor arranged between the positive output terminal and a negative auxiliary terminal to respond to the inverted RF communication terminal; and

a fourth input transistor arranged between the negative output terminal and the negative auxiliary terminal to respond to the RF communication signal.

10. The frequency converter according to claim 9, wherein the driving unit includes N driving stages each having a first driving transistor responding to the oscillation signal of corresponding one of the clock signals and a second driving transistor responding to the inverted oscillation signal of the corresponding one of the clock signals, the first and second driving transistors having first side ends connected to a ground voltage and second side ends electrically connected to the positive and negative auxiliary terminals, respectively, such that a connection of the second side ends of the first and second driving transistors of a driving stage is contrary to that of an adjacent driving stage.

11. The frequency converter according to claim 10, wherein the N is three.

12. The frequency converter according to claim 10, wherein the first input transistor is gated by the RF communication signal and has a conduction path between the first load element and the positive auxiliary terminal, the second input transistor is gated by the inverted RF communication signal and has a conduction path between the second load element and the positive auxiliary terminal, the third input transistor is gated by the inverted RF communication signal and has a conduction path

between the first load element and the negative auxiliary terminal, and the fourth input transistor is gated by the RF communication signal and has a conduction path between the second load element and the negative auxiliary terminal.